

**Post-doctoral Position Project “Stress transmission and fracture in collagen networks”  
12 months**

**Characteristics of the position:**

Functions/ features	Postdoctoral researcher
Employment type	BAP E – E1E45 Expert in scientific computing
Category	A
Body	early career researcher
Quotas	100%

**Assignment:**

The successful candidate will be hosted by the Laboratoire Sols, Solides, Structures, Risques (3SR) - Grenoble, France ([www.3sr-grenoble.fr/](http://www.3sr-grenoble.fr/)) in the CoMHet team and by the Laboratoire Interdisciplinaire de Physique (LIPHY) - Grenoble, France (<https://liphy.univ-grenoble-alpes.fr/en>) in the MC<sup>2</sup> team.

The candidate will be under a fixed-term contract for a period of 12 months at the University of Grenoble Alpes.

**Context and work environment**

**Structure description**

- The 3SR laboratory includes 120 people who carry out cutting-edge research in solid mechanics, within the fields of structural engineering, structures and materials for civil engineering, transportation, manufacturing industry or healthcare. The CoMHet team develops interdisciplinary research focused on the physics and the mechanics of heterogeneous media and their multi-physics couplings. The common objective is to characterize, understand and model the links between the microstructure and the macroscopic mechanical properties of a wide range of porous media composed of fibers, colloids, bio-polymers or grains.  
website: <https://3sr.univ-grenoble-alpes.fr/fr/recherche/equipe-comhet>
- The Interdisciplinary Laboratory of Physics (UMR5588 CNRS and UGA) has a staff of about 200 people. Physics is seen at LIPhy as a general method of approach to complex phenomena in various disciplines. The team Cell Mechanics in Complex Media (MC2) conducts interdisciplinary research based on mechanical and physical approaches to understand the dynamics of living or biomimetic systems and materials (biological fluids, cells and capsules, tissues). The experimental, theoretical and numerical skills allow to approach different biological and bioinspired systems having for common point to present complex physical interactions at different scales.  
Website : <https://liphy.univ-grenoble-alpes.fr/en/mc2>

**Team description :**

He/she will work under the supervision of Dr. M. Bouzid at 3SR and Dr. J. Etienne at LIPhy, in collaboration with Dr. P. Recho, Dr. K. John and Dr. A. Erlich. The candidate will be initially appointed in 3SR and will later stay at LIPhy depending on the progress of the project. He/she will also interact with experimentalists at LIPhy (Dr. C. Verdier, Dr. V. Laurent, Dr. G. Cappello), at 3SR (Dr. L. Bailly and Dr. L. Org as) and at the Laboratoire de Biologie du D veloppement, Paris-Sorbonne (Dr. J. Fouchard).

**Position's mission and main activities:**

**Mission:** Stress transmission and fracture in collagen networks

The project has a duration of 12 months from the date of recruitment expected no later than June 2023.

**Main activities:**

The complex aggregation of proteins organizes collagen fibers into a hierarchical network capable of withstanding mechanical loads. This rigid and resilient material serves as a protective barrier for tissues, skin or cartilage. Although the linear and non-linear elastic properties of these networks are well studied, their local micromechanical response as well as the plastic processes leading to fracture under local or global loads remain poorly understood. The objective is to model the impact of local loading, buckling and sliding of the fibers on the stress transmission and plastic response of the network.

An innovative combination of techniques will be employed, with coarse-grained molecular dynamics simulations of a model gel, containing minimal and generic ingredients to capture the mechanical response of collagen fiber networks, serving as the basis for theoretical efforts. Our project is organized into three work packages:

- Numerical design of collagen gels and characterization of the impact of the gelation protocol on the microstructure.
- Identification of the mechanisms of stress propagation and plastic rearrangements close to the fracture regime.
- Development of a micromechanical model.

This work will be conducted in close collaboration with the experimentalists.

**Restriction or constraints related to the position:**

- Observe the internal rules of both laboratories (3SR/LIPhy).
- Interact with both laboratories (3SR-Liphy) (The two laboratories are 5min walk from each other)
- Use numerical tools (Lammps, python, C++)

**Desired profile:**

- **Trade skills/ expertise**

The candidate must have a numerical and theoretical background in biophysics, and/or soft matter physics, biomechanics or statistical physics with a strong motivation to work at the interface between physics and biology. Specific skills in numerical tools (Python, C++, Lammps) will be highly appreciated.

- **Personal skills**

- Good ability to interact with experimentalists
- Make a link between the two teams
- Good communication skills

Supervisory mission:  Yes  No

**Desired professional experience** :  beginner  2 to 5 years

**Previous formation, diplomas:**

The candidate must hold a PhD in one of these fields physics/biology/mechanics.

<b>General information</b>
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The gross salary is 2750 euros/month, equivalent to a net salary of 2210 euros/month.

Applicants should send their CV and covering letter by e-mail to the following persons :

Contact for the questions related to the position:

**Mehdi Bouzid**, CNRS researcher

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